MEMORANDUM

To: Washington State Climate Advisory Team and its Technical Working Groups

From: Michael Lazarus, Jeff Ang-Olson, Alison Bailie, Katie Bickel, David von Hippel, Stephen Roe, Tom Peterson, Center for Climate Strategies

Re: Methods for quantification of draft greenhouse gas (GHG) mitigation policy options

Date: September 25, 2007

This memo summarizes key elements of the recommended methodology for quantifying the GHG impacts and costs for those TWG policy options that are considered amenable to quantification. Feedback from CAT and TWG members is encouraged. As noted in previous CAT meetings, impacts on clean energy jobs and fuel import expenditures will be quantified for the full suite of policy options, once assembled.[1]

- Common units and results reported:
  - **Net GHG reduction potential** in million metric tons carbon dioxide equivalent (MMTCO2e) using IPCC 100 yr global warming potential, reported for 2012, 2020, and cumulatively 2008-2020. Where significant additional GHG reductions or costs occur beyond the project period as a direct result of actions taken during the project period, these will be indicated as appropriate.
  - **Net present value** (NPV) **cost** (or cost savings) for the period 2008-2020 in 2006 constant dollars, using a 5% real discount rate.[2] Positive numbers represent options with net costs; negative numbers represent options with net cost savings.
  - **Cost per metric ton of CO2 equivalent** emissions reduced (or removed) in units of $/MTCO2e. This figure represents the NPV cost divided by the cumulative emission reductions, both over the 2008-2020 period.

- Consistent assumptions and methodologies: In order to ensure consistent results across options and TWGs, common factors and assumptions will be used for items such as:
  - **Electricity avoided costs and emissions**: Common values ($/MWh and tCO2/MWh) are being developed based on available studies, most notably those of the Northwest Power Planning Council. Once the full set of options is identified, an integrated analysis will be undertaken, and these values may be revised based on the total reduction in requirements for business-as-usual electricity resources.
  - **Fuel costs and projected escalation.** Fuel costs estimates will be based on common sources, wherever possible. For example, fossil fuel price escalation

[1] Input is currently being collected by CTED and CCS on analysis methodology.
[2] Capital investments with lifetimes longer than 2020 are represented in terms of levelized or amortized costs, in order to avoid "end effects".

will be indexed to USDOE projections as indicated in their most recent Annual Energy Outlook.
    - **Emission increasing activities.** Some options may involve some increased demand for energy or other potential emission sources (e.g. plug-in electric vehicles). Such direct emissions increases will be factored into the analysis.[3]

- Aggregation of impacts: Options may overlap in terms of coverage, both within and across sectors. In order to avoid double counting of GHG reduction potential and cost (e.g. more than one option avoiding the same emissions source), interactive effects will be estimated where possible, and emission reduction totals will reflect these overlaps. In other words, the total emissions reductions for the state will be lower than the sum of the results for individual options.

- Geographic scope and lifecycle analysis:
    - **GHG impacts of policy options are estimated regardless of the physical location of emissions reductions**. For instance, a major benefit of recycling is the reduction in material extraction and processing (e.g. aluminum production). While a policy option may increase recycling in Washington state, the reduction in emissions may occur where this material is produced. Where significant emissions impacts are likely to occur outside the state, this will be clearly indicated. These emissions reductions are counted towards the achievement of the state's emission goal, since they result from actions taken by the state.
    - Related to the previous point, **lifecycle analysis** is applied wherever emissions impacts upstream (e.g., production, extraction) or downstream (e.g. waste disposal) from a specific activity constitute a significant fraction of a policy option's emissions impacts *and* studies are sufficient to enable estimation. For example, lifecycle analysis is used to estimate the emissions benefits of biofuels relative to the fossil fuels they might substitute for.

- Transparency: Data sources, methods, key assumptions, and key uncertainties are clearly indicated.

- Cost perspectives and inclusion: The general approach of direct (NPV) cost and cost-effectiveness analysis is used, as widely applied to GHG mitigation policy options.[4] Included are the direct, economic costs from the perspective of the state as whole (e.g. avoided costs of electricity rather than consumer electricity prices). This bottom-up approach is relatively transparent and is capable of reflecting the costs (and cost savings)

[3] Some policy options could also result in emissions leakage, either positive or negative. Negative leakage would occur if a policy leads emitting activities to shift to areas outside its target area, or increases activity as a result of lowering the cost of service (e.g. the rebound effect). For example, if not considered carefully, policies to protect forest lands could shift forest clearing activities to other regions or states. Conversely, some policy options could result in positive leakage, through replication outside the target area, e.g. by lowering the price or increasing access to lower-emitting technologies. Where such effects might be significant, these should be noted qualitatively.
[4] See e.g. Section 2.4 of the IPCC Fourth Assessment Report, Working Group III, for more discussion of various economic analysis approaches. http://www.mnp.nl/ipcc/pages_media/AR4-chapters.html

associated with an individual policy option, in contrast to macroeconomic analysis, which aims to capture flows and interactions across all sectors of the economy. Potential macroeconomic impacts, costs or benefits that fall disproportionately on specific groups or actors, as well external costs and benefits, should be noted qualitatively, especially where studies or other information are available.

Examples of costs included:

- Capital costs levelized (amortized) where appropriate, e.g. for improved buildings, vehicles, equipment upgrades, new technologies, manure digesters and associated infrastructure, ethanol production facilities, mass transit investment and operating expenses (net of any saved infrastructure costs such as roads)
- Operation, maintenance, and other labor costs (or incremental costs relative to standard practice),
- Fuel and material costs, e.g. for natural gas, electricity, biomass resources, water, fertilizer, material use, electricity transmission and distribution
- Other direct costs administrative and other costs (where readily estimated), such as the grid integration costs for renewable energy technologies, or the costs of administering an energy efficiency project, or of implementing smart growth programs (net of saved infrastructure costs)

Examples of costs or benefits not included:

- External costs such as the monetized environmental or social benefits/impacts (value of damage by air pollutants on structures, crops, etc.), quality-of-life improvements, or improved road safety, or other health impacts and benefits
- Energy security benefits
- Macroeconomic impacts related to the impact of reduced or increased consumer spending, shifting of cost and benefits among actors in the economy
- Potential revenues from participation in a carbon market